

TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

1960.235

U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.53)

60/136,766

09/744682

INTERNATIONAL APPLICATION NO.

PCT/CA00/00617

INTERNATIONAL FILING DATE

26 May 2000 (26.05.00)

PRIORITY DATE CLAIMED

29 May 1999 (29.05.99)

TITLE OF INVENTION

FLUID TREATMENT SYSTEM AND CLEANING APPARATUS THEREFOR

APPLICANT(S) FOR DO/EO/US

TROJAN TECHNOLOGIES INC.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the application time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(I).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☒ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
 ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information: Notification of Transmittal of the International Search Report Or Declaration



U.S. APPLICATION NO. (If known, see 37 CFR 1.5)

INTERNATIONAL APPLICATION NO

60/136,755

09/744682

PCT/CA00/00617

ATTORNEY'S DOCKET NUMBER

1960.235

17. ☒ The following fees are submitted:**Basic National Fee (37 CFR 1.492(a)(1)-(5):**

Search Report has been prepared by the EP or JPO \$860.00

International preliminary examination fee paid to USPTO

(37 CFR 1.492(a)(1)) \$690.00

No international preliminary examination fee paid to USPTO (37 CFR 1.492

(a)(1)) but international search fee paid to USPTO (37 CFR 1.492(a)(2)) \$710.00

Neither international preliminary examination fee (37 CFR 1.492(a)(1))

nor international search fee (37 CFR 1.492(a)(2)) paid to USPTO \$1,000.00

International preliminary examination fee paid to USPTO (37 CFR 1.492

(a)(4)) and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00

ENTER APPROPRIATE BASIC FEE AMOUNT =

\$1,000.00

Surcharge of \$130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months
from the earliest claimed priority date (37 CFR 1.492(e)).

\$

Claims	Number Filed	Number Extra	Rate
Total Claims	29	-20 = 9	X \$18.00
Independent Claims	2	-3 = 0	X \$80.00
Multiple dependent claim(s) (if applicable)			+ \$270.00

\$162.00

\$000.00

\$000.00

TOTAL OF ABOVE CALCULATIONS =

\$1,162.00

Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement
must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).

\$

SUBTOTAL =

\$1,162.00

Processing fee of \$130.00 for furnishing the English translation later than ☐ 20
☒ 30 months from the earliest claimed priority date (37 CFR 1.492(f)).

\$

TOTAL NATIONAL FEE =

\$1,162.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be
accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property +

\$

TOTAL FEES ENCLOSED =

\$1,162.00

Amount to be:**refunded** \$**charged** \$a. ☐ A check in the amount of \$_____ to cover the above fees is enclosed.b. ☒ Please charge my Deposit Account No. 50-1710 in the amount of \$ 1,162.00 to cover the above fees. A duplicate copy
of this sheet is enclosed.c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment
to Deposit Account No. 50-1710. A duplicate copy of this sheet is enclosed.**NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR
1.137(a) or (b)) must be filed and granted to restore the application to pending status.**

SEND ALL CORRESPONDENCE TO:

PATENT ADMINISTRATOR

KATHEN MUCHIN ZAVIS

525 West Monroe Street

Suite 1600

Chicago, Illinois 60661-3693

Facsimile: 312-902-1061

SIGNATURE

RICHARD P. BAUER

January 29, 2001

NAME

DATE

31.588

REGISTRATION NUMBER

TRANSMITTAL LETTER TO THE UNITED STATES
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15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information: Notification of Transmittal of the International Search Report Or Declaration

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY
STATUS (37 CFR 1.96) AND 1.27 (c)) - SMALL BUSINESS CONCERN**

Docket No.
13202.00265

Serial No.

09/744,682

Filing Date

26 May 2000

Patent No.

Issue Date

Applicant/ **TROJAN TECHNOLOGIES INC.**
Patentee:

Invention: **FLUID TREATMENT SYSTEM AND CLEANING APPARATUS THEREFOR**

I hereby declare that I am:

- ☐ the owner of the small business concern identified below:
- ☒ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF CONCERN: Trojan Technologies Inc.ADDRESS OF CONCERN: 3020 Gore Road, London, Ontario, Canada N5V 4T7

I hereby declare that the above-identified small business concern qualifies as a small business concern as defined in 37 CFR 1.96, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the above identified invention described in:

- ☐ the specification filed herewith with title as listed above.
- ☒ the application identified above.
- ☐ the patent identified above.

If the rights held by the above-identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed on the next page and no rights to the invention are held by any person, other than the inventor, who could not qualify as an independent inventor under 37 CFR 1.9(c) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

- ☒ no such person, concern or organization exists.
☐ each such person, concern or organization is listed below.

FULL NAME _____

ADDRESS _____

☐ Individual

☐ Small Business Concern

☐ Nonprofit Organization

FULL NAME _____

ADDRESS _____

☐ Individual

☐ Small Business Concern

☐ Nonprofit Organization

FULL NAME _____

ADDRESS _____

☐ Individual

☐ Small Business Concern

☐ Nonprofit Organization

FULL NAME _____

ADDRESS _____

☐ Individual

☐ Small Business Concern

☐ Nonprofit Organization

Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING:

Martin J. Bracken

TITLE OF PERSON SIGNING

OTHER THAN OWNER:

Intellectual Property Specialist

ADDRESS OF PERSON SIGNING:

SIGNATURE:

Martin J. Bracken

DATE:

JUNE 5, 2001

1960.235

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)
: Examiner: NYA
VIVIAN DALL'ARMI, ET AL.)
: Group Art Unit: NYA
Application No.: NYA)
:
Filed: January 29, 2001)
:
For: FLUID TREATMENT SYSTEM) January 29, 2001
AND CLEANING APPARATUS)
THEREFOR)

Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Sir:

Prior to examination on the merits, kindly amend
the above-identified application as follows:

IN THE CLAIMS:

Kindly amend Claims 3-11, and 14-29 as follows:

Claim 3

Line 1, change "1-2" to --1--.

Claim 4

Line 1, change "1-3" to --1--.

Claim 5

Line 1, change "1-4" to --1--.

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Claim 6

Line 1, change "1-5" to --1--.

Claim 7

Line 1, change "1-6" to --1--.

Claim 8

Line 1, change "1-7" to --1--.

Claim 9

Line 1, change "1-8" to --1--.

Claim 10

Line 1, change "1-9" to --1--.

Claim 11

Line 1, change "1-10" to --1--.

Claim 14

Line 1, change "12-13" to --12--.

Claim 15

Line 1, change "12-14" to --12--.

Claim 16

Line 1, change "12-15" to --12--.

Claim 17

Line 1, change "12-16" to --12--.

Claim 18

Line 1, change "12-17" to --12--.

Claim 19

Line 1, change "12-18" to --12--.

Claim 20

Line 1, change "12-19" to --12--.

Claim 21

Line 1, change "12-20" to --12--.

Claim 22

Line 1, change "12-21" to --12--.

Claim 23

Line 1, change "12-22" to --12--.

Claim 24

Line 1, change "12-23" to --12--.

Claim 25

Line 1, change "12-24" to --12--.

Claim 26

Line 1, change "12-25" to --12--.

Claim 27

Line 1, change "12-26" to --12--.

Claim 28

Line 1, change "12-27" to --12--.

Claim 29

Line 1, change "12-28" to --12--.

Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 625-3500. All correspondence should continue to be directed to our address given below.

Respectfully submitted,


Attorney for Applicants

Registration No. 31,588

PATENT ADMINISTRATOR
KATTEN MUCHIN ZAVIS
525 West Monroe Street
Suite 1600
Chicago, Illinois 60661-3693
Facsimile: (312) 902-1061

-1- 525 Rec'd PCT/PTO 29 JAN 2001

FLUID TREATMENT SYSTEM AND CLEANING
APPARATUS THEREFOR

TECHNICAL FIELD

5 In one of its aspects, the present invention relates to a cleaning apparatus for use in a fluid treatment system. In another of its aspects, the present invention relates to a fluid treatment system comprising the cleaning apparatus.

BACKGROUND ART

10 Fluid treatment systems are known generally in the art.

For example, United States patents 4,482,809, 4,872,980 and 5,006,244 (all in the name of Maarschalkerweerd and all assigned to the assignee of the present invention and hereinafter referred to as the Maarschalkerweerd #1 Patents), the contents of each of which are hereby incorporated by reference, all
15 describe gravity fed fluid treatment systems which employ ultraviolet (UV) radiation.

Such systems include an array of UV lamp frames which include several UV lamps each of which are mounted within sleeves which extend between and are supported by a pair of legs which are attached to a cross-piece. The so-
20 supported sleeves (containing the UV lamps) are immersed into a fluid to be treated which is then irradiated as required. The amount of radiation to which the fluid is exposed is determined by the proximity of the fluid to the lamps, the output wattage of the lamps and the fluid's flow rate past the lamps. Typically, one or more UV sensors may be employed to monitor the UV output of the lamps
25 and the fluid level is typically controlled, to some extent, downstream of the treatment device by means of level gates or the like.

However, disadvantages exist with the above-described systems. Depending upon the quality of the fluid which is being treated, the sleeves surrounding the UV lamps periodically become fouled with foreign materials,
30 inhibiting their ability to transmit UV radiation to the fluid. For a given installation, the occurrence of such fouling may be determined from historical operating data or by measurements from the UV sensors. Once fouling has

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reached a certain point, the sleeves must be cleaned to remove the fouling materials and optimize system performance.

If the UV lamp modules are employed in an open, channel-like system (e.g., such as the one described and illustrated in Maarschalkerweerd #1 Patents), one or more of the modules may be removed while the system continues to operate, and the removed frames may be immersed in a bath of suitable cleaning solution (e.g., a mild acid) which may be air-agitated to remove fouling materials. Of course, this necessitates the provision of surplus or redundant sources of UV radiation (usually by including extra UV lamp modules) to ensure adequate irradiation of the fluid being treated while one or more of the frames has been removed for cleaning. This required surplus UV capacity adds to the capital expense of installing the treatment system. Further, a cleaning vessel for receiving the UV lamp modules must also be provided and maintained. Depending on the number of modules which must be serviced for cleaning at one time and the frequency at which they require cleaning, this can also significantly add to the expense of operating and maintaining the treatment system. Furthermore, this cleaning regimen necessitates relatively high labor costs to attend to the required removal/re-installation of modules and removal/re-filling of cleaning solution in the cleaning vessel. Still further, such handling of the modules results in an increased risk of damage to or breakage of the lamps in the module.

If the frames are in a closed system (e.g., such as the treatment chamber described in United States patent 5,504,335 (in the name of Maarschalkerweerd and assigned to the assignee of the present invention), the contents of which are hereby incorporated by reference), removal of the frames from the fluid for cleaning is usually impractical. In this case, the sleeves must be cleaned by suspending treatment of the fluid, shutting inlet and outlet valves to the treatment enclosure and filling the entire treatment enclosure with the cleaning solution and air-agitating the fluid to remove the fouling materials. Cleaning such closed systems suffers from the disadvantages that the treatment system must be stopped while cleaning proceeds and that a large quantity of cleaning solution must be employed to fill the treatment enclosure. An additional problem exists in that

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handling large quantities of cleaning fluid is hazardous and disposing of large quantities of used cleaning fluid is difficult and/or expensive. Of course open flow systems suffer from these two problems, albeit to a lesser degree.

Indeed, it is the belief of the present inventors that, once installed, one of the largest maintenance costs associated with prior art fluid treatment systems is often the cost of cleaning the sleeves about the radiation sources.

United States patents 5,418,370, 5,539,210 and 5,590,390 (all in the name of Maarschalkerweerd and all assigned to the assignee of the present invention and hereinafter referred to as the Maarschalkerweerd #2 Patents), the contents of each of which are hereby incorporated by reference, all describe an improved cleaning system, particularly advantageous for use in gravity fed fluid treatment systems which employ UV radiation. Generally, the cleaning system comprises a cleaning sleeve engaging a portion of the exterior of a radiation source assembly including a radiation source (e.g., a UV lamp). The cleaning sleeve is movable between: (i) a retracted position wherein a first portion of radiation source assembly is exposed to a flow of fluid to be treated, and (ii) an extended position wherein the first portion of the radiation source assembly is completely or partially covered by the cleaning sleeve. The cleaning sleeve includes a chamber in contact with the first portion of the radiation source assembly. The chamber is supplied with a cleaning solution suitable for removing undesired materials from the first portion of the radiation source assembly.

The cleaning system described in the Maarschalkerweerd #2 Patents represents a significant advance in the art, especially when implemented in the radiation source module and fluid treatment system illustrated in these patents. More specifically, the cleaning system described in the Maarschalkerweerd #2 Patents is particularly useful in municipal wastewater treatment facilities in which the cleaning system is employed in combination with an ultraviolet radiation treatment system disposed an open channel comprising a gravity fed flow of fluid. After treatment, the fluid is then discharged into a stream, creek, river, lake or other body of water.

Clean water treatment systems present a unique set of challenges since the fluid being treated in the system is a source of potable/drinking water. If the

cleaning system described in the Maarschalkerweerd #2 Patents were implemented in a clean water treatment system, there would be a significant likelihood of leakage of the cleaning solution from the chamber into the fluid being treated. It is desirable to avoid such leakage of cleaning solution from the
5 cleaning system.

Thus, notwithstanding the advances in the art provided by the cleaning system taught in the Maarschalkerweerd #2 Patents, there remains a need in the art for a cleaning apparatus which may be implemented advantageously, inter alia, in a clean water treatment system.

10

DISCLOSURE OF THE INVENTION

It is an object of the invention to provide a cleaning apparatus which obviates or mitigates at least one of the above-mentioned disadvantages of the prior art.

15 Accordingly, in one of its aspects, the present invention provides a cleaning apparatus for use in a fluid treatment system comprising a radiation source assembly, the cleaning apparatus comprising:

at least one cleaning sleeve in sliding engagement with the exterior of the radiation source assembly;

20 a first chamber disposed in the at least one cleaning sleeve in contact with a portion of the exterior of the radiation source assembly and for being supplied with a cleaning solution;

a second chamber disposed in the at least one cleaning sleeve adjacent the first chamber;

25 seal means to restrict movement of fluid between the first chamber and the second chamber; and

drive means to translate the at least one cleaning sleeve along the exterior of the radiation source assembly.

In another of its aspects, the present invention provides a fluid treatment
30 device comprising a housing for receiving a flow of fluid, the housing comprising:

a fluid inlet;

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a fluid outlet;
a fluid treatment zone disposed between the fluid inlet and the fluid outlet;
a radiation source assembly disposed in the fluid treatment zone for treatment of the flow of fluid; and

- 5 a cleaning apparatus comprising: at least one cleaning sleeve in sliding engagement with the exterior of the radiation source assembly; a first chamber disposed in the at least one cleaning sleeve in contact with a portion of the exterior of the radiation source assembly and for being supplied with a cleaning solution; a second chamber disposed in the at least one cleaning sleeve adjacent
10 the first chamber; seal means to prevent substantially unrestricted movement of fluid between the first chamber and the second chamber; first drain means to withdraw fluid from the second chamber; and drive means to translate the at least one cleaning sleeve along the exterior of the radiation source assembly.

Thus, the present inventors have developed a novel cleaning device for
15 use in a fluid treatment system. The cleaning device contains two "independent" chambers. Specifically, there is provided a cleaning chamber for containing a cleaning solution in contact with an exterior of a radiation source assembly. A second chamber is provided in the cleaning sleeve substantially adjacent the first chamber. The second chamber, in essence, functions as a fluid (typically water)
20 buffer layer between the cleaning chamber and the fluid being treated. Thus, the fluid buffer layer acts to receive small amounts of cleaning solution which may leak from the cleaning chamber thereby obviating or mitigating passage of the cleaning fluid to the fluid being treated.

The cleaning chamber and the chamber defining the fluid buffer layer are
25 relatively "independent" of one another. This may be achieved by using a seal between the two chambers. Since even the highest quality seals are likely to allow some leakage of cleaning fluid, the fluid buffer layer in the second chamber adjacent the cleaning chamber acts to obviate or mitigate alternate leakage of the cleaning fluid into the fluid being treated. This renders the present cleaning
30 system advantageous for use in a clean water application where the fluid being treated is, for example, potable water.

When implemented in a fluid treatment system for clean water

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applications, it is conventional to dispose the treatment system in a closed pipe containing a pressurized (e.g., 150 psig) flow of water. If the cleaning solution in the cleaning chamber and the fluid in the second chamber acting as the fluid buffer layer are maintained at a pressure lower than the pressure of the fluid flow through the fluid treatment system, there is, in essence, a pressure drop across the region of the fluid flow and the two chambers of the cleaning device. This pressure drop assists in obviating or mitigating leakage of fluid from the cleaning chamber through the second chamber to the fluid being treated.

In a preferred embodiment, the second chamber defining the fluid buffer layer further includes a drain to remove fluid from the second chamber. This further obviates or mitigates leakage of cleaning solution from the cleaning chamber through the second chamber to the fluid being treated.

In a further preferred embodiment, the cleaning chamber is provided with a supply and drain to add and remove cleaning solution to and from the cleaning chamber. In a further preferred embodiment, this supply and drain in the cleaning chamber is comprised in a recirculation system which allows for addition of cleaning solution, as required.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will be described with reference to the accompanying drawings, in which:

Figure 1 illustrates a schematic, in cross-section, of a preferred embodiment of the present cleaning device;

Figure 2 and 3 illustrate side elevations, in cross-section, of a preferred embodiment of a fluid treatment device comprising a preferred embodiment of the present cleaning apparatus;

Figures 4 and 5 illustrate enlarged side elevations, cross-section of the cleaning apparatus illustrated in Figures 2 and 3, respectively; and

Figure 6-8 illustrate photographs of a particularly preferred embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

With reference to Figure 1, there is illustrated a cleaning apparatus 10. Cleaning apparatus 10 comprises a cleaning sleeve 15. Cleaning sleeve 15 comprises a cleaning chamber 20 and a pair of second chambers 25,30. Cleaning sleeve 15 is disposed over a radiation source assembly 35 comprising a radiation source 40 enclosed within a protective sleeve 45.

Cleaning chamber 20 is separated from second chambers 25,30 by a pair of seals 50,55.

Second chambers 25,30 are sealed from the exterior of the cleaning sleeve 15 by a pair of annular seals 60,65. Cleaning sleeve 15 is reversibly movable along the exterior of protective sleeve 45 in the direction of arrow A. The actuation of cleaning sleeve 15 along the exterior of protective sleeve 45 will be described in more detail hereinbelow.

Cleaning sleeve 15 further comprises a drain 70 from each of second chambers 25,30. Drain 70 may be utilized at atmospheric pressure. Of course, the illustrated embodiment could be modified to have a single drain from one of second chambers 25,30, and by providing communication between second chambers 25,30. Further, a cleaning solution supply inlet 75 is provided in cleaning sleeve 15 and serves to allow for supply of cleaning solution to cleaning chamber 20. Also, a cleaning supply outlet 80 is provided to allow for withdrawal of cleaning solution from cleaning chamber 20.

With reference to Figures 2 and 3, there is illustrated a fluid treatment device 100 comprising an inlet 105, an outlet 110 and a housing 115. A pair of opposed flanges 120,125 are disposed at opposite ends of housing 115. A pair of opposed cover plates 130,135 are attached to flanges 120,125, respectively, to provide, in the case of treating liquids, a fluid-tight seal.

Disposed in housing 115 is a radiation source assembly 140 comprising a pair of radiation, preferably ultraviolet radiation, lamps 145 disposed within a protective sleeve 150 - e.g., a quartz sleeve.

Disposed adjacent cover plate 135 is a cleaning apparatus 200. Cleaning apparatus 200 comprises a pair of rods 205,210 which are slidably moveable through cover plate 135. Attached to the ends of rods 205,210 is a cleaning

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sleeve 300, the details of which will be described below. Attached to the other ends of rods 205,210 is a plate 215 which is connected to a slide 219 movable along a rail 220. Rail 220 is a conventional electric screw drive which is connected to an electric motor (not shown) or other electric motive means. The electric motor serves to rotate the screw (not shown) which translates slide 219 along rail 220 thereby moving plate 215.

With reference to Figures 4 and 5, a more detailed explanation of the design of cleaning sleeve 300 will be provided. Thus, cleaning sleeve 300 comprises a sleeve element 305 which surrounds and is movable over protective sleeve 150 of radiation source assembly 140 (see Figures 2 and 3). Sleeve element 305 includes a chamber 310 for receiving a cleaning fluid - in Figure 5, the cleaning fluid is shown in solid black. Cleaning chamber 310 is coupled to an elbow connector 315 which in turn is coupled to rod 205 and, ultimately, plate 215. A line 320 is connected to plate 215 and in turn to rod 205 via an elbow connector 325. The other end of line 320 is connected to a supply of cleaning fluid (not shown). The cleaning fluid may be acetic acid or any other suitable fluid which will facilitate removal of fouling materials (e.g., minerals, algae and the like) from the surface of protective sleeve 150. In essence, cleaning chamber 310 is defined by a pair of seals 330,335 which, when sleeve 300 is mounted on quartz sleeve 150, form a substantially fluid-tight type seal. Seals 330,335 are annular seals which surround quartz sleeve 150. Substantially adjacent seals 330,335 are a pair of Teflon™ bearings 340,345, respectively.

Adjacent Teflon™ bearing 340,345 are a pair of second seals 350,355, respectively.

With reference to Figure 4, in essence, Teflon™ bearings 340,345 are disposed in a chamber 360 defined between seals 330,335 and 350,355, respectively. This can be seen clearly in Figure 4 which illustrates a flow of fluid in black from second chamber 360.

Opposite elbow connection 315 attached to sleeve element 305 is another elbow element 365 which is connected to rod 210 and in turn to plate 215.

As will be apparent, rod 210 includes a coaxial line which serves two purposes. First, with reference to Figure 5, cleaning fluid (shown in black) may

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be removed from cleaning chamber 310 via an internal line 370 in rod 210. The disposition of line 370 in this manner creates a second line 375 coaxially disposed around line 370. The function of line 375 is illustrated in Figure 4 and served to remove fluid from second chamber 360. Thus, rod 210 serves to both remove
5 cleaning solution from chamber 310 and independently remove fluid from second chamber 360.

Preferably lines 320 and 370 are connected to a recirculation pump which allows for cleaning solution to be recirculated through cleaning sleeve 300 as illustrated in Figure 5 (the cleaning solution is shown in black. Recirculation can
10 be continuous or on a periodic basis. It should be apparent that the cleaning solution may be circulated in the reverse direction to that described above.

In operation, when it is desired to clean the exterior of protective sleeve 150, the electrically driven screw (not shown) in rail 220 is actuated thereby moving plate 215 with respect to rail 220. This results in movement of cleaning
15 sleeve 300 over protective sleeve 150. Such cleaning can be done while fluid treatment device 100 is in operation or while it has been shut down for maintenance or another reason. Further, it is possible to design the dimensions of housing 115 such that cleaning sleeve 300 may be parked in a position in housing 115 such that it does not interfere with the hydraulic flow of fluid
20 through the device. As will be apparent to those of skill in the art. Figure 2 shows cleaning sleeve in the fully extended (i.e., into housing 115) position whereas Figure 3 illustrates cleaning sleeve in a retracted position.

While the present invention has been described with reference to preferred and specifically illustrated embodiments, it will of course be understood by those
25 of skill in the arts that various modifications to these preferred and illustrated embodiments may be made without the parting from the spirit and scope of the invention.

All publications, patents and patent applications referred to herein are incorporated by reference in their entirety to the same extent as if each individual
30 publication, patent or patent application was specifically and individually indicated to be incorporated by reference in its entirety.

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What is claimed is:

1. A cleaning apparatus for use in a fluid treatment system comprising a radiation source assembly, the cleaning apparatus comprising:
 - at least one cleaning sleeve in sliding engagement with the exterior of the radiation source assembly;
 - a first chamber disposed in the at least one cleaning sleeve in contact with a portion of the exterior of the radiation source assembly and for being supplied with a cleaning solution;
 - a second chamber disposed in the at least one cleaning sleeve adjacent the first chamber;
 - seal means to restrict movement of fluid between the first chamber and the second chamber; and
 - drive means to translate the at least one cleaning sleeve along the exterior of the radiation source assembly.
2. The cleaning apparatus defined in claim 1, further comprising first drain means to withdraw fluid from the second chamber.
3. The cleaning apparatus defined in claims 1-2, further comprising second drain means to withdraw cleaning fluid from the first chamber.
4. The cleaning apparatus defined in claims 1-3, further comprising supply means to supply cleaning fluid to the first chamber.
5. The cleaning apparatus defined in claims 1-4, wherein the first chamber comprises a first annular chamber substantially surrounding the exterior of the radiation source assembly.
6. The cleaning apparatus defined in claims 1-5, wherein the second chamber comprises a pair of second annular chambers on opposed sides of the first chamber and substantially surrounding the exterior of the radiation source

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assembly.

7. The cleaning apparatus defined in claims 1-6, wherein the pair of second annular chambers are in communication with one another.

8. The cleaning apparatus defined in claims 1-7, wherein the seal means defines a barrier between the first chamber and the second chamber.

9. The cleaning apparatus defined in claims 1-8, further comprising second seal means disposed between the at least one cleaning sleeve and the exterior of the radiation source assembly.

10. The cleaning apparatus defined in claims 1-9, wherein the radiation source assembly comprises at least one radiation source disposed in a protective sleeve.

11. The cleaning apparatus defined in claims 1-10, wherein the protective sleeve comprises a quartz sleeve.

12. A fluid treatment device comprising a housing for receiving a flow of fluid, the housing comprising:

a fluid inlet;

a fluid outlet;

a fluid treatment zone disposed between the fluid inlet and the fluid outlet;

a radiation source assembly disposed in the fluid treatment zone for treatment of the flow of fluid; and

a cleaning apparatus comprising: at least one cleaning sleeve in sliding engagement with the exterior of the radiation source assembly; a first chamber disposed in the at least one cleaning sleeve in contact with a portion of the exterior of the radiation source assembly and for being supplied with a cleaning solution; a second chamber disposed in the at least one cleaning sleeve adjacent the first chamber; seal means to prevent substantially unrestricted movement of fluid between the first chamber and the second chamber; first drain means to

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withdraw fluid from the second chamber: and drive means to translate the at least one cleaning sleeve along the exterior of the radiation source assembly.

13. The fluid treatment device defined in claim 12, wherein the cleaning apparatus further comprises first drain means to withdraw fluid from the second chamber.

14. The fluid treatment device defined in claims 12-13, wherein the cleaning apparatus further comprises second drain means to withdraw cleaning fluid from the first chamber.

15. The fluid treatment device defined in claims 12-14, wherein the cleaning apparatus further comprises supply means to supply cleaning fluid to the first chamber.

16. The fluid treatment device defined in claims 12-15, wherein the first chamber comprises a first annular chamber substantially surrounding the exterior of the radiation source assembly.

17. The fluid treatment device defined in claims 12-16, wherein the second chamber comprises a pair of second annular chambers on opposed sides of the first chamber and substantially surround the exterior of the radiation source assembly.

18. The fluid treatment device defined in claims 12-17, wherein the pair of second annular chambers are in communication with one another.

19. The fluid treatment device defined in claims 12-18, wherein the seal means defines a barrier between the first chamber and the second chamber.

20. The fluid treatment device defined in claims 12-19, wherein the cleaning

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apparatus further comprises second seal means disposed between the at least one cleaning sleeve and the exterior of the radiation source assembly.

21. The fluid treatment device defined in claims 12-20, wherein the protective sleeve comprises a quartz sleeve.

22. The fluid treatment device defined in claims 12-21, wherein the fluid treatment zone comprises a substantially elongate irradiation zone.

23. The fluid treatment device defined in claims 12-22, wherein the radiation source assembly comprises at least one radiation source disposed in a protective sleeve.

24. The fluid treatment device defined in claims 12-23, wherein the at least one radiation source is substantially elongate.

25. The fluid treatment device defined in claims 12-24, wherein the at least one radiation source is disposed substantially parallel to a flow of fluid through the irradiation zone.

26. The fluid treatment device defined in claims 12-25, wherein the at least one radiation source is disposed substantially transverse to a flow of fluid through the irradiation zone.

27. The fluid treatment device defined in claims 12-26, wherein the fluid inlet, the fluid outlet and the fluid treatment zone are arranged in a substantially collinear manner.

28. The fluid treatment device defined in claims 12-27, wherein the fluid inlet, the fluid outlet and the fluid treatment zone have substantially the same cross-section.

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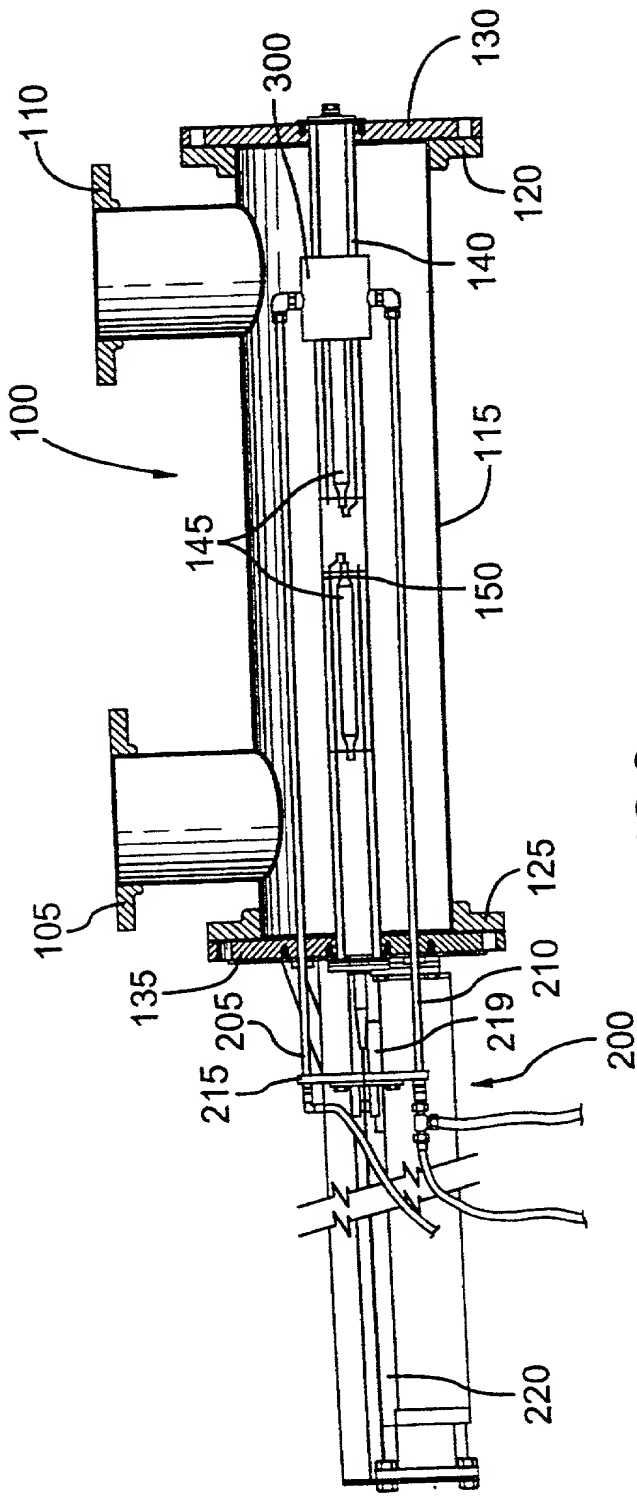


FIG.2

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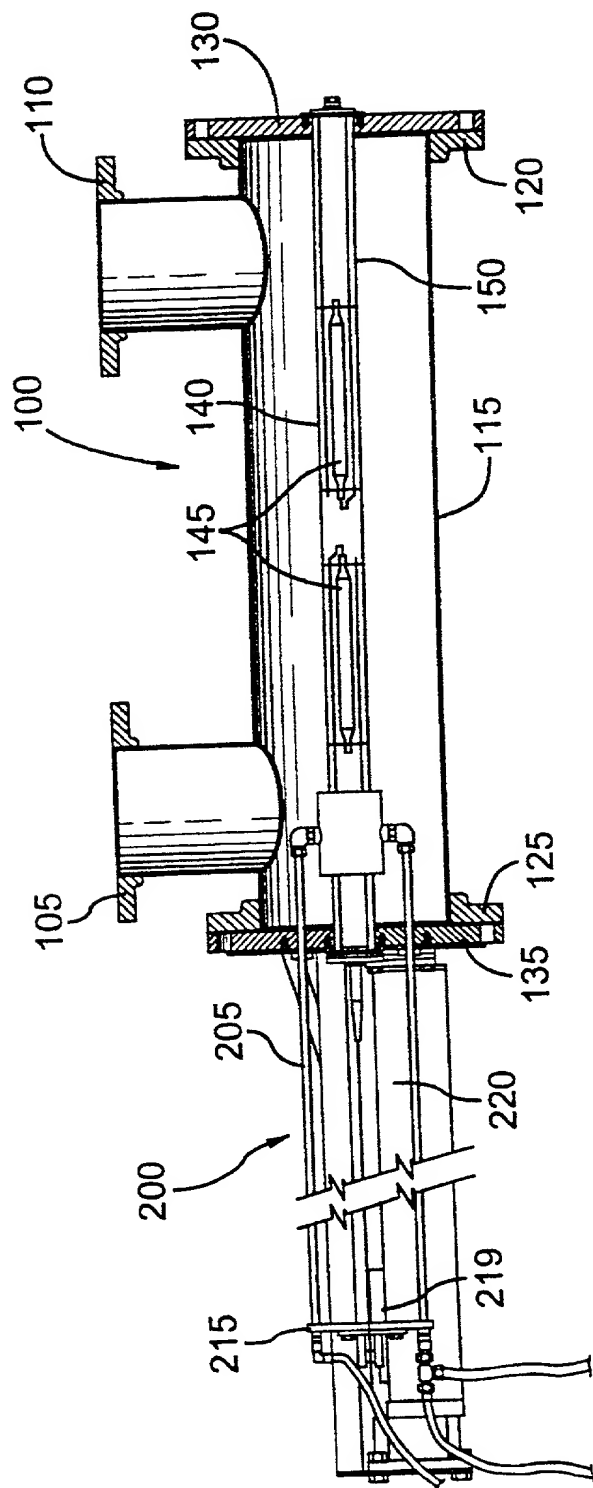
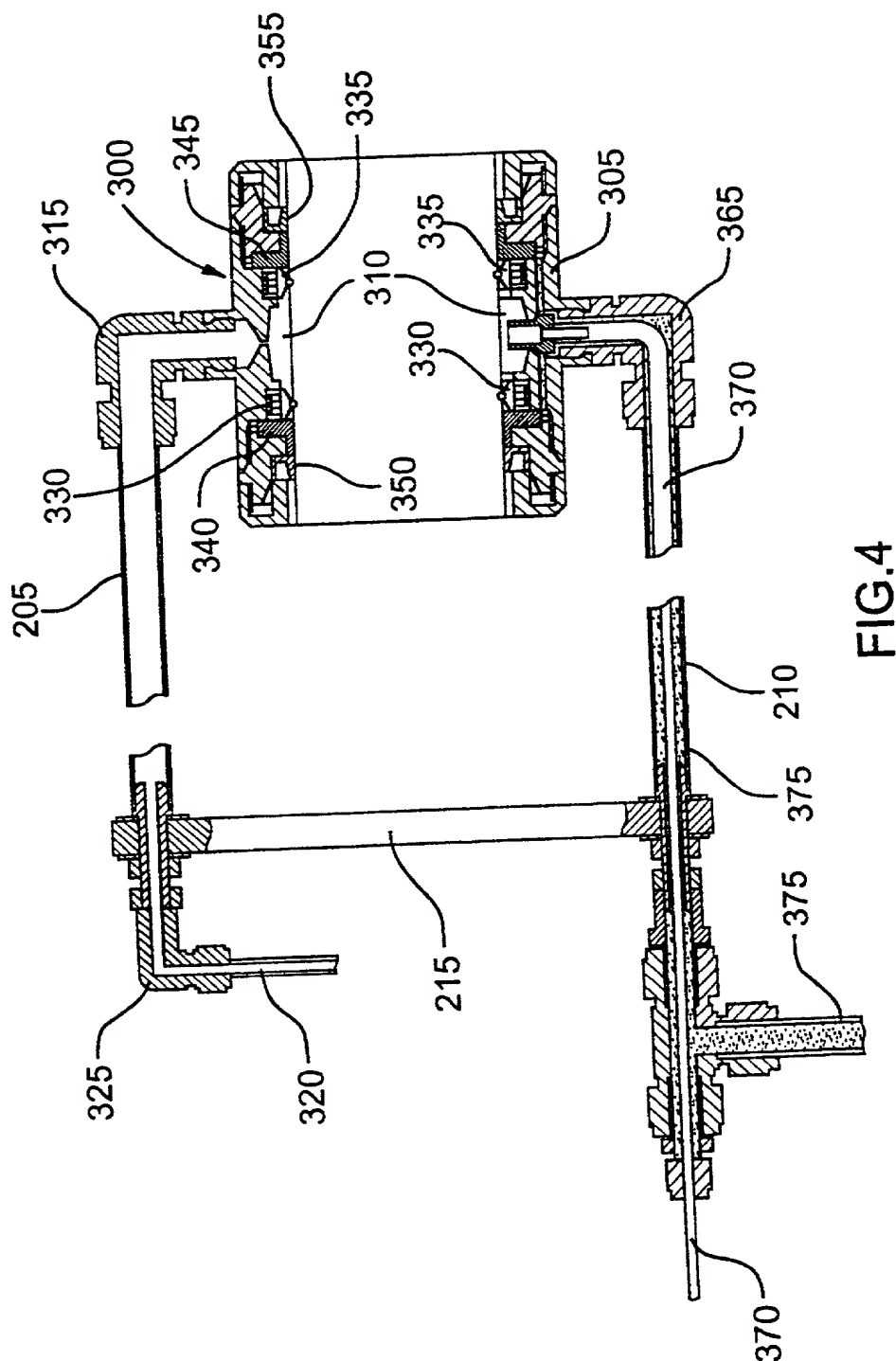


FIG.3



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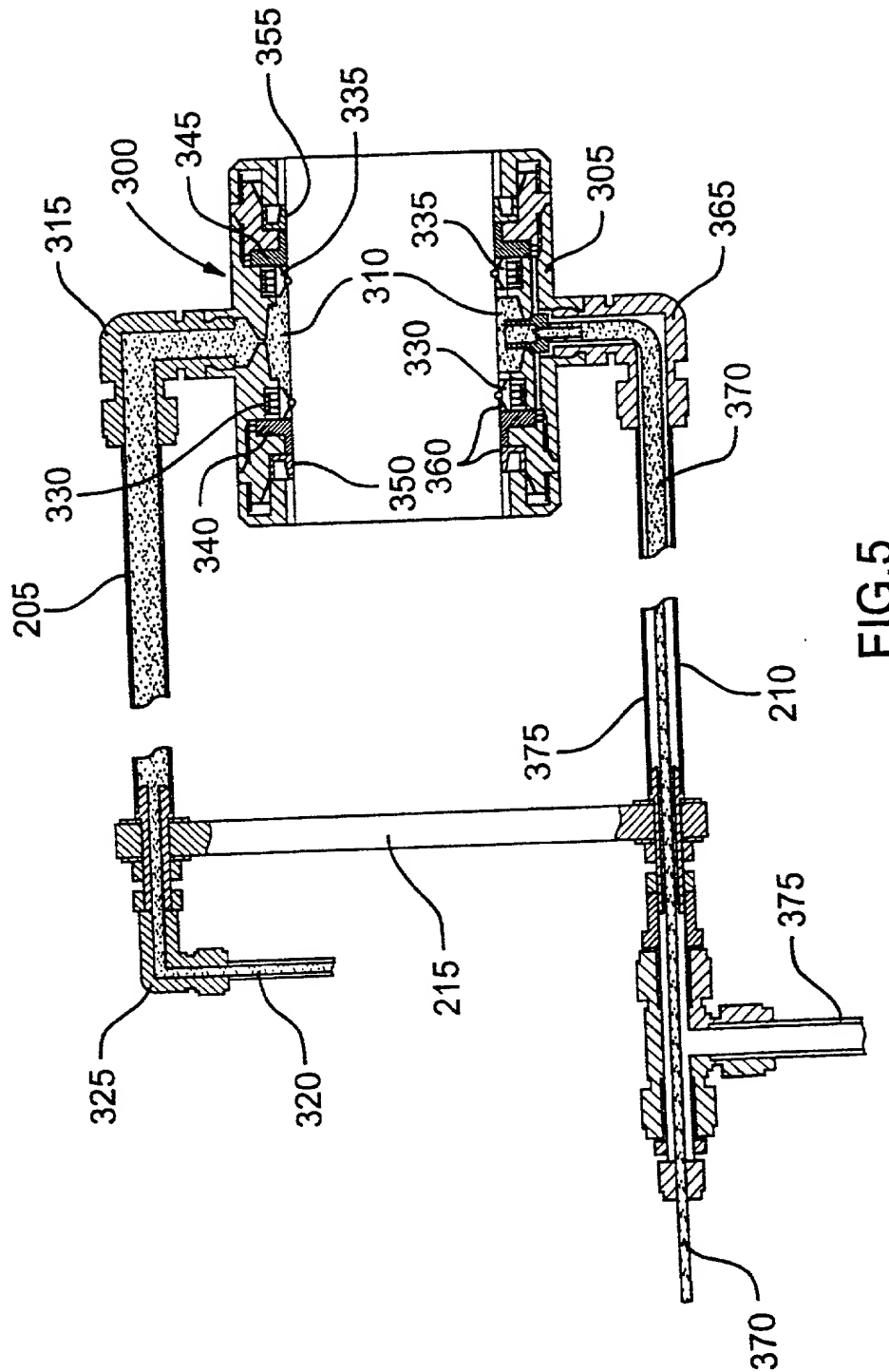


FIG. 5

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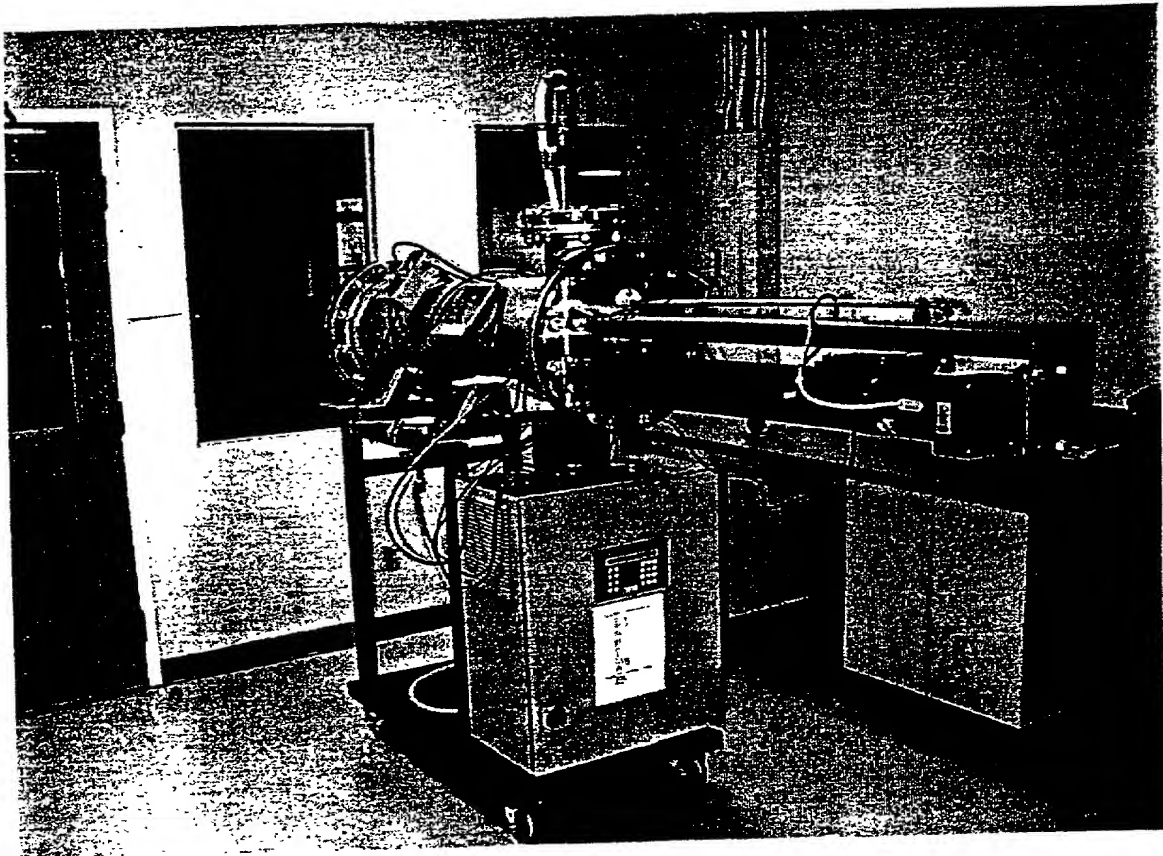


FIG. 6

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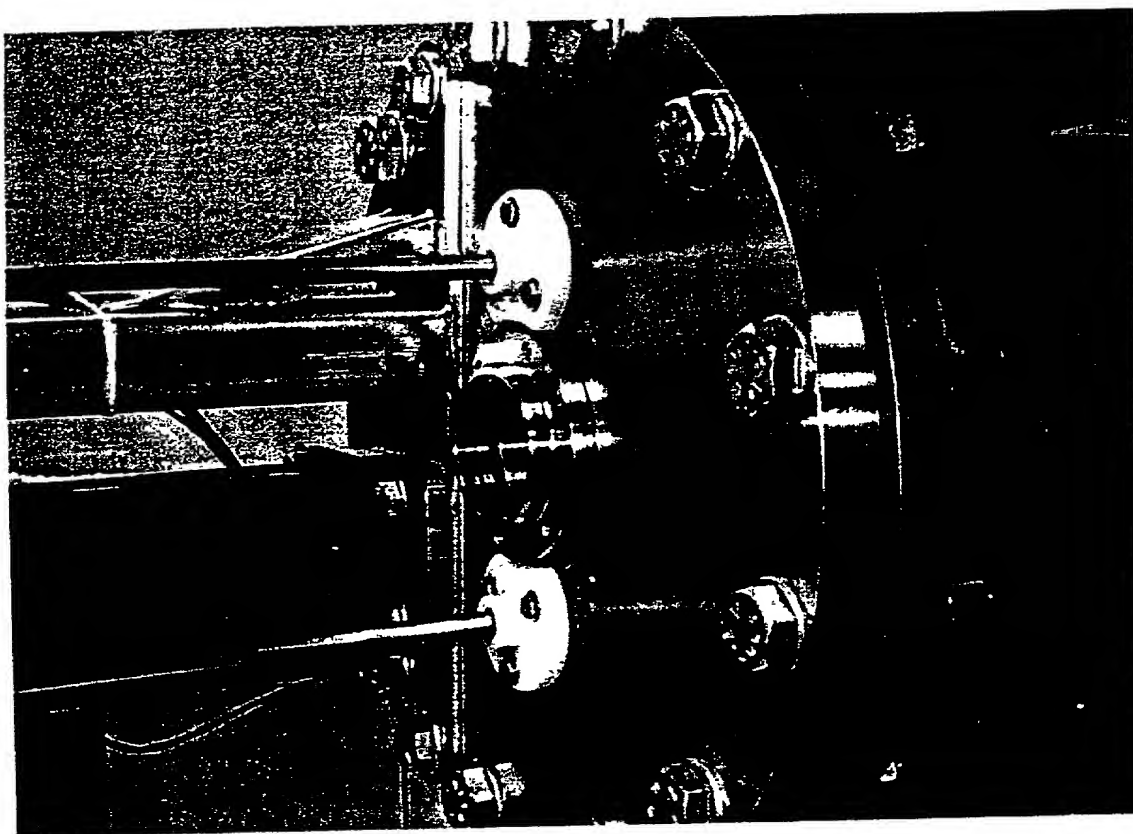


FIG. 7

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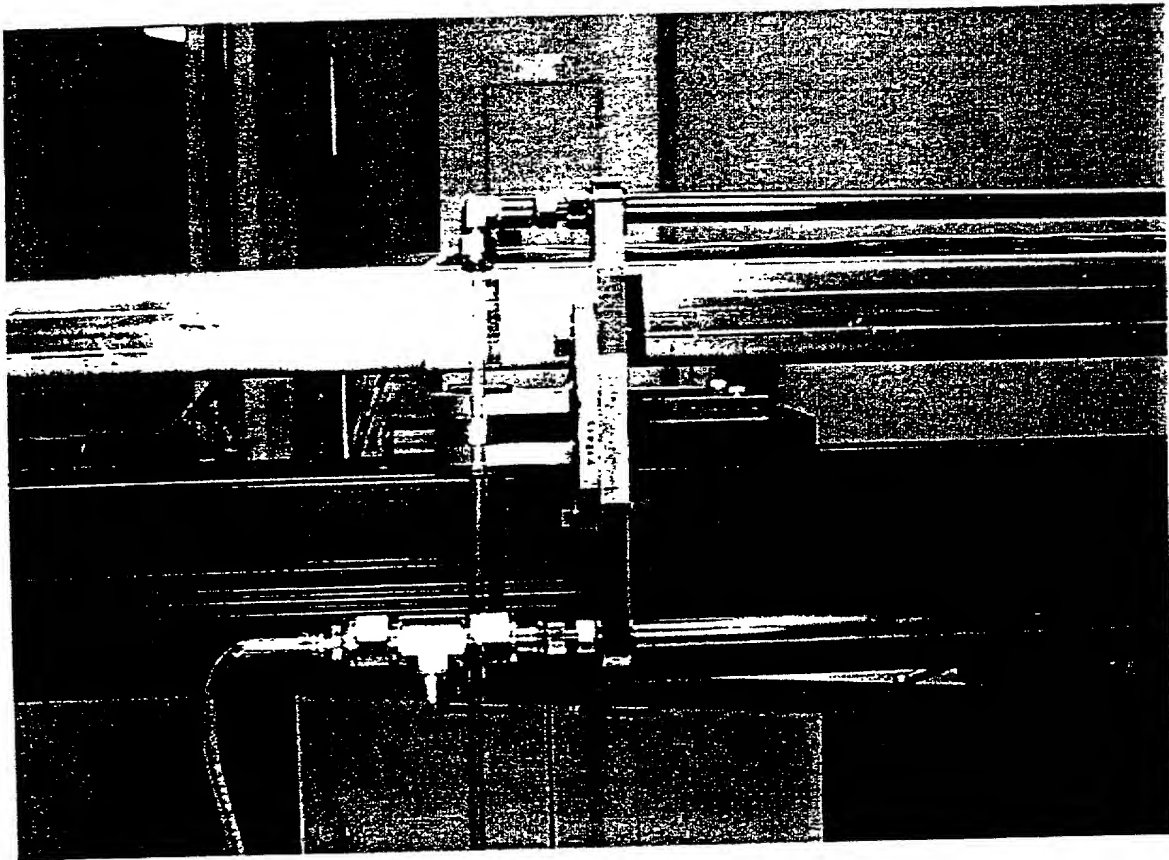


FIG. 8

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paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

Application No. Filed (Day/Mo./Yr.) Status
(Patented, Pending, Abandoned)

I hereby appoint the practitioners associated with the firm and Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and direct that all correspondence be addressed to the address associated with that Customer Number:

KATTEN MUCHIN ZAVIS
Customer Number: 27160

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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May 31, 2001